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FROM	RONALD B. MILLER
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FAX NUMBER	PATENT APP 10/601/464
SUBJECT	Answer And Complaint Request For New Examination

*Return Receipt Requested**1 OF 17**① OF 17*

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Friday, May 27, 2006

COMMISSIONER FOR PATENTS
PO BOX 1450
Alexandria VA 22313-1450Attn: Ishwar Patel, Examiner
Art Unit 2841
RE: 10/601/464
RE: Office Action Summary 4/27/06 from Ishwar Patel
RE: Response to Office Action Summary 11/29/2005
RE: Notice of Non-Compliant Amendment sent on 12/29/05 by D Bell
RE: my Letter and amendment of December 26, 2005

Dear Mr Patel,

I object to the Status being FINAL. I will try to meet the objections below, but the Claim Rejections are erroneous as will be evident from my answers detailed below on a line-item basis.

The following changes may be made in order to facilitate your understanding.

However, you have a problem. This is not a module, THIS IS NOT A MODULE THIS IS NOT A MICROWAVE ASSEMBLY, THIS IS NOT A MMIC, THIS IS NOT ANYTHING LIKE THE ITEMS YOU HAVE BEEN COMPARING IT WITH.

Item 2. The title of the invention is not descriptive(YOU SAY).

Please substitute the following Title: A multi-layer printed circuit board with internal segments of electrical connections suspended in air dielectric.

Item 3.

Claim 1: (Currently amended)

1. A multi-layer printed circuit board (PCB) (see figure 2) with internal signal traces on a thin dielectric layer with said traces on dielectric layers suspended in air between two flat metal plates. Suspension in air is accomplished by indentation of the flat metal plates above and below the trace and a distance away from the

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edges of the trace, leaving the remainder of the metal away from the indentation to act as a spacer. The indented area is referred to as a "channel". See FIG. 1 for orthogonal view and FIG. 2 for end-on view, with said signal traces connected to vias which penetrate through the PCB to the top and bottom surfaces connecting other electronic components either by through-hole mounting where the via hole is large and a component lead is inserted in the via, or by surface mount connection wherein said metal plates have oversized holes in the metal filled with insulation material larger than the via aligned with each via electrically isolating the via from the plate, and mechanically fixing the position of the via relative to the metal plate, with the via being electrically connected to the signal trace by a pad at the end of the trace aligned with and joined to the via.

Claim 4

Claim 17. (Currently amended)

The PCB of claim 1 wherein laminating metal to metal may use an adhesive coating or an adhesive sheet. The adhesive will have no effect on electrical high-speed performance because the thin dielectric of the adhesive with wide metal plates forms a high-frequency capacitive short from top to bottom plates.

Item 4 (Insert Concluding claim per paragraph 2 of 35 U.S.C. 112).

This PCB patent is differentiated from existing PCB patents and technology in that the air dielectric conductors are laminated within the PCB, and being differentiated from other assemblies such as modules, circuits and the like in that this is by its very nature a laminated PCB for electrical inter-connection of or mounting of other components.

Item 5

Standard PCB's do not use an adhesive sheet between adjacent metal layers, but rather use pre-preg, a partially cured fiberglass reinforced epoxy. In this application the use of adhesive to bond adjacent metal layers is a requirement unique to this patent.

Claim 17 (Currently amended)

The PCB of claim 1 wherein laminating metal to metal may use an adhesive coating or an adhesive sheet is used to bond adjacent metal layers together.

Item 6

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Contrary to your assertion that the invention is patented or described in a printed publication, this invention has not been used or patented. None of the technical journals contains the subject matter of this invention.

The problem is a lack of communication between the examiner and myself as to the subject matter, because of the specialized nature of this subject matter.

Suspended substrate was invented and patented back in the 1950's using a dielectric sheet with a trace bolted together between two metal shields, with air an air cavity above and below the transmission line. Since that time filters have used the same suspended substrate technology because of the need for higher Q factor.

However suspended substrate has never been achieved in a PCB because of the difficulty of fabrication. I have spoken to many PCB fabrication companies over the last few years and none of them have even heard of it.

The difficulty of fabrication lies in the normal use of a vacuum during lamination so that the air is drawn from the air space leaving a vacuum inside the board causing the board to collapse into that cavity. The use of a vacuum during lamination cannot be allowed.

A vacuum is normally used during lamination to draw out all entrapped air because entrapped air which can cause mechanical damage and de-lamination of the layers when the outside pressure is reduced as at high altitudes.

In order to make this invention reliable the entrapped air must be channeled to the outside of the PCB to allow PCB to breathe air in and out, equalizing the pressure inside and outside.

The value of air dielectric structure is in allowing very high frequency signals including digital signals at multi-gigabit data rates to pass without distortion and to travel at the speed of light.

Item 7:

Claims 1-4, 7, 24 and 17 are not anticipated by Shiau (US Patent no. 5,319,329)

Regarding claim 1, Shiau does not disclose a printed circuit board with internal traces, but rather discloses a MMIC compatible bandpass filter.

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④



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Whereas this printed circuit board invention is a structure on which components are mounted and interconnected, a MMIC compatible bandpass filter patented by Shiau is a component that might be mounted on a printed circuit board.

Whereas this printed circuit board invention is laminated together during manufacture to provide a rigid base for mounting other components, Shiau uses hardware to assemble the MMIC filter into a module which has open ends for interconnecting with and integrating into a complete MMIC assembly. This printed circuit board invention has no such openings for connection

Whereas this printed circuit board is sized to meet the interconnect and mounting requirements for many components, Shiau's filter is made as small as possible to fit within a MMIC.

Whereas this printed circuit board uses air as the primary dielectric in order to pass all high-frequency signals without discrimination, and digital signals at data rates as used in computers today, Shiau's filter is used to select one frequency while rejecting others as is common in radio communications, radar, and microwave test equipment.

Whereas this printed circuit board has a conductive trace traversing the structure from one component mounting pad to another, Shiau has a complex set of conductive traces which do not connect the input to the output. Shiau depend on mutual coupling of the filter elements which are isolated at low frequencies.

Regarding claim 2-4, "fabrication".

withdrawn

Regarding claim 7, "dielectric layer strength vs thickness"

withdrawn

Withdrawn for simplicity.

However, please note that since Shiau did not meet the claimed invention because he did not fabricate it within a PCB.

Regarding claim 14 "air channels" Shiau did not have traces internal to a PCB, so he had no need to add air channels to equalize air pressure. The channels seen in the patent of Shiau were simply a side effect of not enclosing the MMIC module by adding end plates and he obviously did not recognize the importance of this within a multi-layer PCB laminated under hundreds of pounds of pressure and hundreds of degrees of heat. He had no idea.

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Regarding claim 17 "adhesive between metals" The need for adhesive between metals as noted in this claim is because for those in the PCB fabrication industry will immediately recognize that pre-preg is not being used between metal layers as an adhesive so something else must provide the bonding. Accordingly, the use of adhesive between metal layers is necessary.

Item 8.

(a)... If the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains shall not be negated by the manner in which the invention was made.

Regarding claim 13, You state that Shiau discloses all the features of the claimed invention.

1. Nowhere does Shiau mention the use of multi-layer printed circuit board, which is a necessary ingredient in order to embed this air dielectric transmission line in a printed circuit board. His two layer board could not be used in this way.
2. Accordingly, Shiau does not mention putting his filter inside a printed circuit board, on the contrary he puts a circuit board in his filter. Just the opposite of this invention.
3. Additionally, Shiau does not mention his invention mounting and connecting components. Only in microwave is the PCB the circuit itself. In all other applications including this invention, a PCB is used for mounting and connecting components into an assembly. So, Shiau has differentiated his MMIC filter from other PCBs and especially from digital electronics.

TRACE SIZE

You state that the size of the trace depends on the signal transmitting capacity. That is true only for microwave assemblies. Not for my printed circuit board. The width of the trace is determined by the target impedance, typically 50 ohms, the height and the dielectric constant of the dielectric material. Impedance is proportional to the height/width ratio and is inversely proportional to the square root of the dielectric constant. The dimensions given are typical for a multi-layer printed circuit board. Copper thickness is typically .7 mils for 1/2 ounce per square foot copper.

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The spacer layer thickness is not based on controlling the electromagnetic fields, because the air channel within metal is essentially a faraday cage. However, the thickness is again related to the height/width ratio and is based on maintaining the target impedance, while using standard available materials.

Shiau could not have anticipated the need of today for higher data rate electrical connections, because his invention was simply for a type of filter to be embedded in a MMIC using suspended substrate for his filter for use in a microwave system.

Response to Arguments

9. Your response to my arguments only shows your lack of knowledge and understanding of present day digital circuit board technology, so I find it necessary now to report a complaint to your superiors and to request a hearing on the matter. Please do not take this as complaint against your person. You simply do not have the background to be able to understand the subject matter.

Conclusion

10. Your conclusion is totally without merit.

Glance(US Patent no. 3,863,181) figure 2 clearly shows a module with a printed circuit board within it. The claims are for a microwave module. My invention is for a PCB with an air dielectric line within the board which is altogether different especially so because the application is primarily for digital high-speed PCBS.

Quan(US Patent no 5,412,354) figure 1 clearly shows a module with a printed circuit board within it. The claims are for a microwave module. Again, my invention is for a PCB with an internal air dielectric line.

10. You have made your action final, so I request a new examiner that understands printed circuit boards especially with focus on digital electronics.

Yours truly,

Ronald B. Miller

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U.S. Patent

May 2, 1995

Sheet 1 of 2

5,412,354

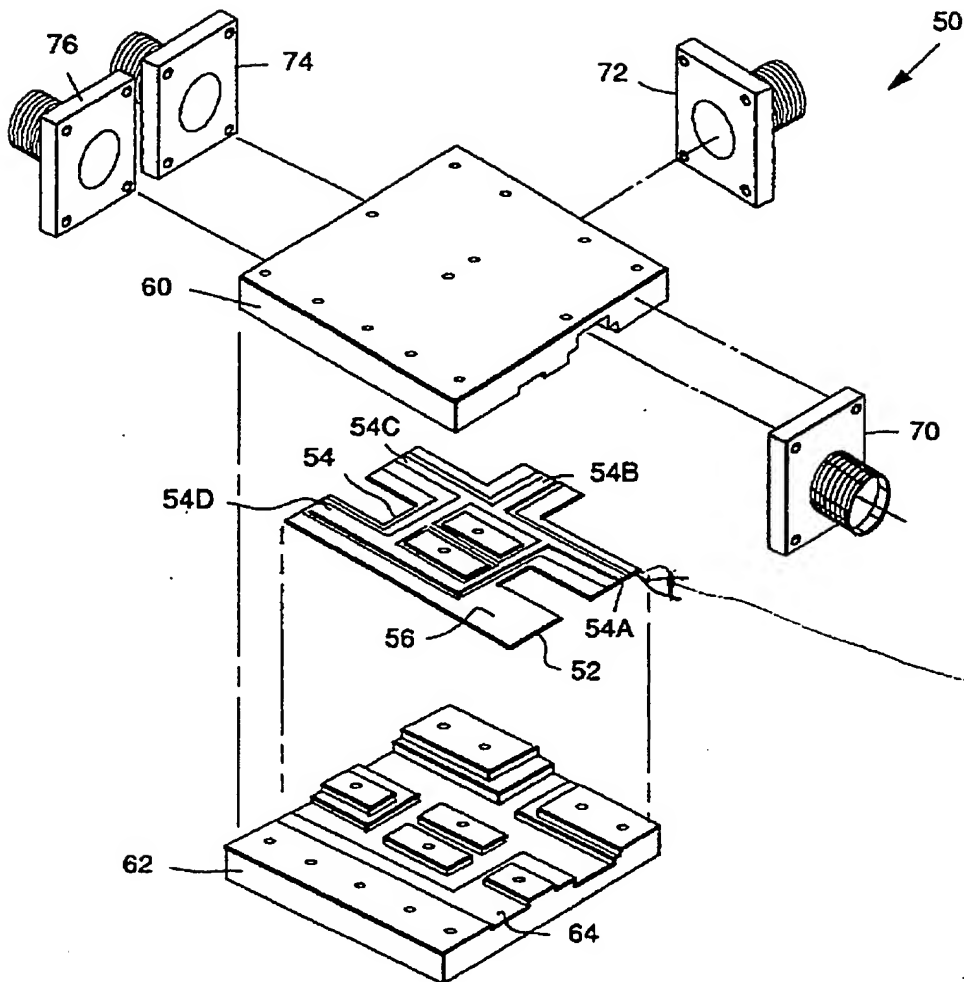
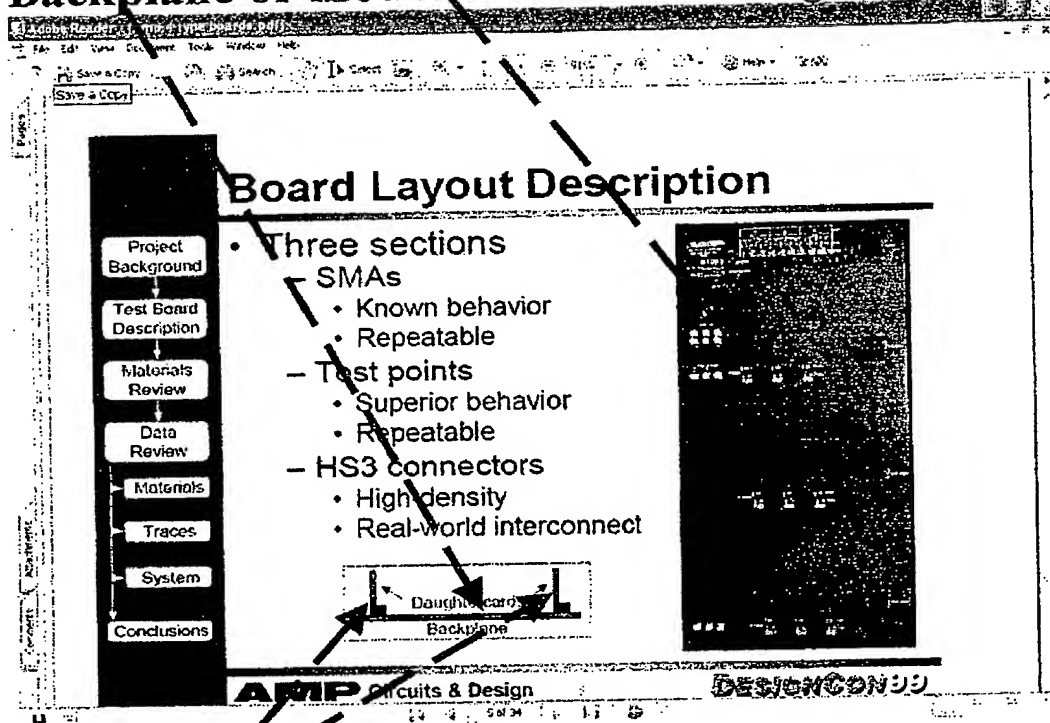


FIG. 1

This is Microwave Module
This is NO PCB (PCB is A part)
(S)

Typical multi-layer printed circuit board

Backplane or motherboard with daughter cards



Daughter cards

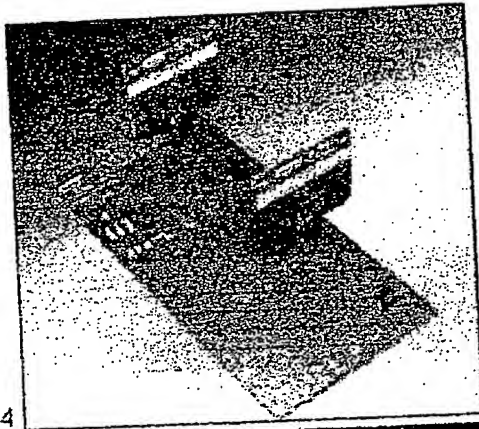
Plugged into backplane

⑨

STANDARD 1

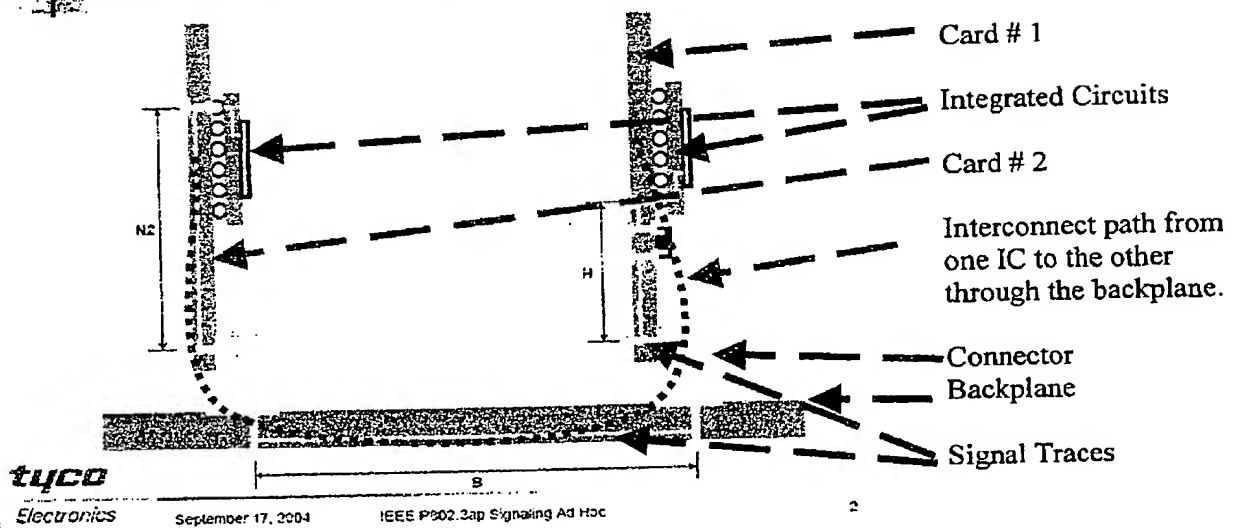
Picture of daughtercards plugged into mother board

NOTE THAT THERE IS NO OTHER FUNCTION EXCEPT INTERCONNECT... NO FILTER OR MMIC OR SUCH



≥ 10 FR4

**Interconnection of high-speed traces
In a typical Switching or computing system**



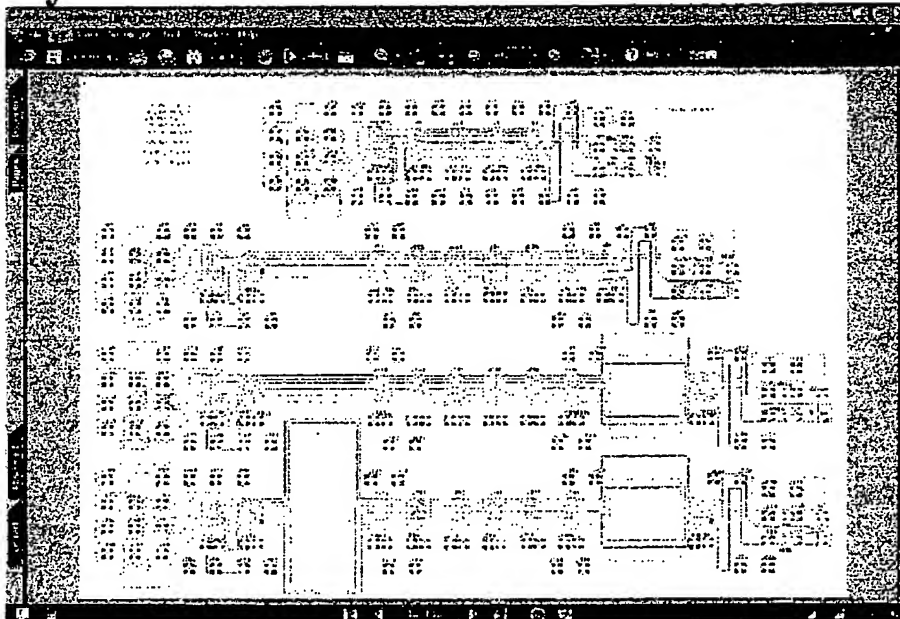
(10)

STANDARD 2

Typical Multi-layer PCB Stack-of layers (Isola)

Layer	Material	Thickness	Notes
1	FR-4	0.0050	Top Layer
2	FR-4	0.0050	Prepreg
3	FR-4	0.0050	Core
4	FR-4	0.0050	Prepreg
5	FR-4	0.0050	Core
6	FR-4	0.0050	Prepreg
7	FR-4	0.0050	Core
8	FR-4	0.0050	Prepreg
9	FR-4	0.0050	Core
10	FR-4	0.0050	Prepreg
11	FR-4	0.0050	Core
12	FR-4	0.0050	Prepreg
13	FR-4	0.0050	Core
14	FR-4	0.0050	Prepreg
15	FR-4	0.0050	Core
16	FR-4	0.0050	Bottom Layer

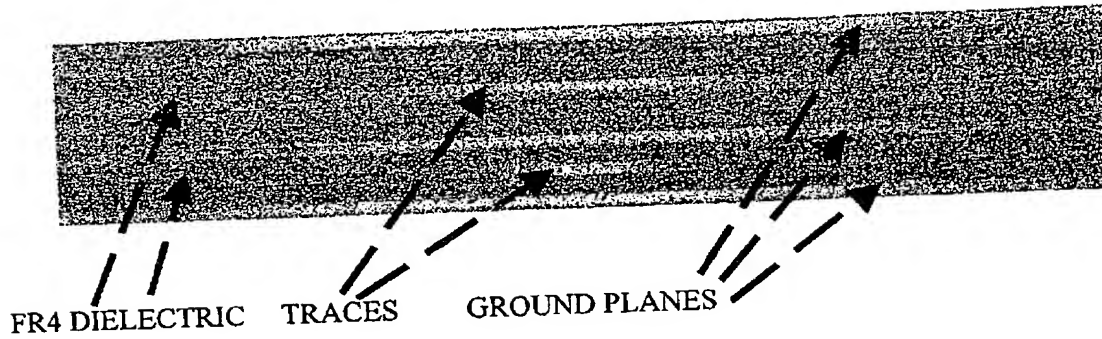
Typical Multi-layer PCB showing only one trace layer imbedded in the board



11

STANDARD 3

**Two strip-line traces inside PCB
With ground separating trace layers
Before lamination with other layers**



(12)

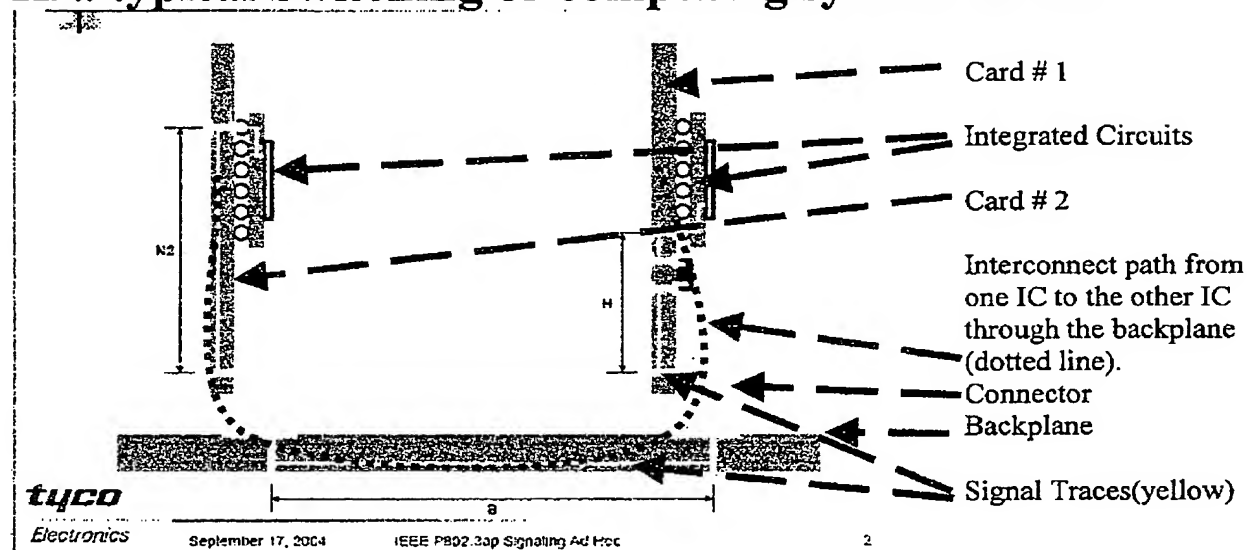
Standard 4

This invention " A multi-layer printed circuit board with internal segments of electrical connections suspended in air dielectric."

Formerly known as "A method for embedding an air dielectric transmission line in a printed wiring board(PWB)."

Suspended Substrate (air dielectric) multi-layer PCB's look exactly the same as other PCB's on the outside.

**Interconnection of high-speed traces
In a typical Switching or computing system below.**



Suspended 1

13

1

Stack-of layers Suspended-Substrate air dielectric Multi-layer PCB

- **Similar to standard technology**
- **Some copper layers(spacers) replace FR4**
- **Adhesive to bond the board(no pre-preg)**
- **The spacer is etched with channel above and below traces to provide air dielectric**
- **The remainder of the spacer acts as a spacer**
- **The channel is extended to a breathing via**
- **This breathing via allows air to flow from the inside to the outside of the board preventing pressure buildup as outside air pressure changes relative to the inside air.**
- **This prevents stress and damage to the board**

Suspended 2

(14)

2

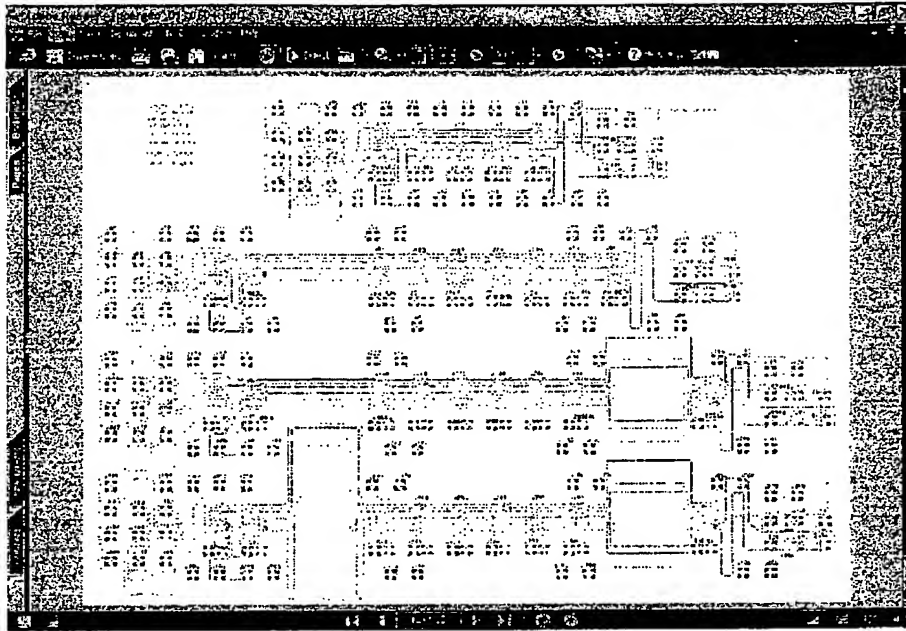
Layer	Thickness	Grayscale Section Diagram	Description	Type	Content	Spec
1-1	0.5		Pre & Picking	Mask		24
1-2	0.5		Face Only	Mask		24
1-3	0.5			Mask		24
1-4	0.5			Mask		24
1-5	0.5			Mask		24
1-6	0.5			Mask		24
1-7	0.5			Mask		24
1-8	0.5			Mask		24
1-9	0.5			Mask		24
1-10	0.5			Mask		24
1-11	0.5			Mask		24
1-12	0.5			Mask		24
1-13	0.5			Mask		24
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1-99	0.5			Mask		24
1-100	0.5			Mask		24

The trace layers are just like on standard multi-layer PCB
These are sandwiched between the spacer layers

Suspended 3

15

3



Suspended 4

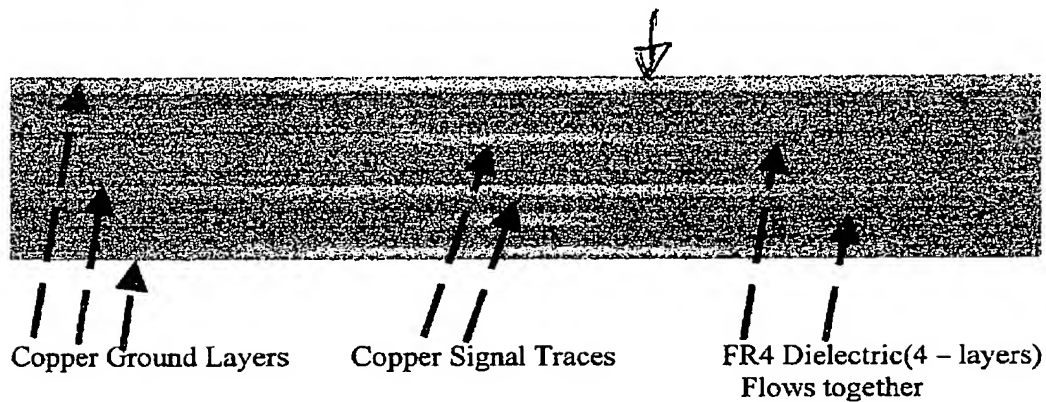
4

16

Two trace layers –

- of normal stack-up of many layers.
- Two strip-line traces inside PCB
- With ground separating trace layers
- Before lamination with other layers

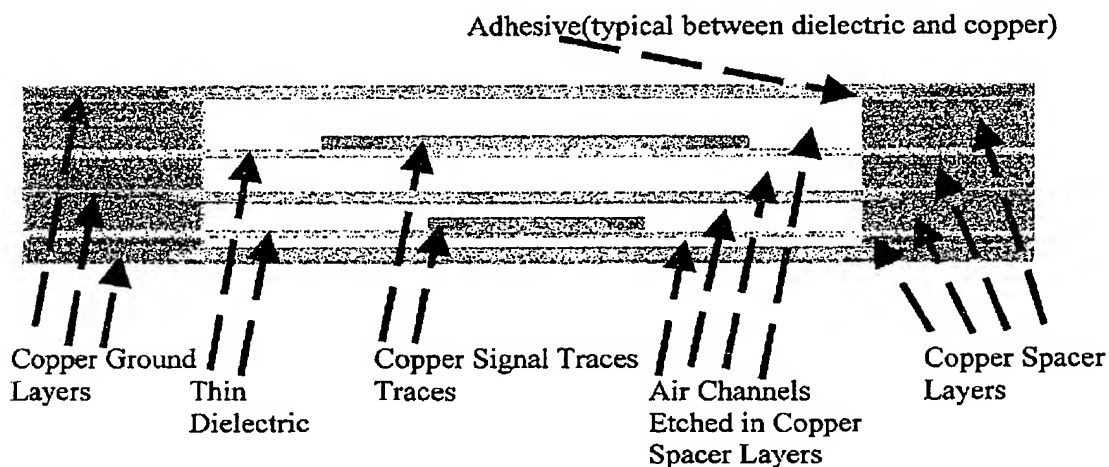
Normal Construction – FR4 dielectric



Present Invention(below)

Suspended substrate – air dielectric

- Many Layers stacked above and below
- Standard Layers mixed with air dielectric layers
- Standard Layers used on top and bottom of stackup



(17)

Suspended 5₅

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